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RESEARCH ARTICLE

SYNTHESIS OF SILVER NANOPARTICLES USING DIFFERENT TYPES OF ORNAMENTAL FLOWER EXTRACTS AND ITS ANTIBACTERIAL ACTIVITY

***Parimala, K. S., Seelibalaji and Nithiyasoundari, M.**

Department of Microbiology, School of Life Science, VELS University, Pallavaram, Chennai, Tamilnadu, India

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ABSTRACT

The main objective of this study was to determine the synthesis of silver nanoparticles and its antibacterial activity tested the different flower species. The flower plants namely; Rangoom creeper, yellow bauhinia, water hycinath, scarlet cordia, senna alata, golden shower, and sausage flower. The silver nanoparticles were synthesized by using 1mM silver nitrate solution through the flower extracts which act as a reducing as well as capping agent. Among these flower extract only four plants showed the positive result for the synthesized silver nanopparticles and it characterized by UV-spec and FTIR. Based on the extract the antibacterial activity was carried out against common fish pathogenic bacteria namely; *Aeromonas hydrophila, Pseudomonas aeruginosa, Vibrio cholera* and *Edwardsiella tarda.* In general, synthesized AgNps showed the strong antibacterial activity.

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INTRODUCTION

Nano technology is mainly concerned with synthesis of nanopparticles variable size, shapes, chemical composition and controlled dispersity and their potentional use for human benefits (Elumalai *et al*., 2010). In the past few years, the potential of various plants for the synthesis of silver nanoparticles (SNPs) was explored. In the present study, we have explored the green synthesis of silver nanoparticles using ornamental flower extract. When compared to microbes, plant mediated synthesis actively practicising by the researchers for its positively advantage like avoiding of maintenance of culture, time consuming and cost effective (Farooqui *et al*., 2010). Silver nanoparticles are well known as one of the most universal antimicrobial substances in the field of biology and medicine due to their strong biocidal effect against microbial species, which has been used for centuries to prevent and treat various diseases, most notably infections(Peter Logeswari *et al*., 2012; Steven, 2015 and Masudur Rahman *et al*., 2011). Soare *et al*. concluded that the extracts obtained from Hyacinthus orientalis flowers have antimicrobial activity and exhibit antioxidant properties similar to those of different medicinal plants (Soare *et al*., 2012). Several plants like *Cinnamon zeylanicum*, Cuury leaves, Neem, Sunflower, Spinach, Sugarcane, Eucalyptus, Coriander, Capsicum, Cassia auriculata flower, Papaya fruit, Phyllathin extract (Gayathramma *et al*., 2013; Sathishkumar *et al*., 2009; Shikuo Li *et al*., 2007; Tripathy A Ashok *et al*., 2010; Velavan *et al*., 2012 and Sathyavathi *et al*., 2010). Senna alalta, golden shower flower, sausage flower, and hycinathus flowers are ornamental flower. It used as medicinal applications. Flowering plants including herbs and trees.

They are widely distributed in most tropical and subtropical countries. Cassia species have biological and pharmacological activities and have many medicinal uses in traditional system of medicine. They are reported for antimicrobial and antioxidant activity. Many reports have shown that some Cassia species contain antimicrobial substances, particularly *Cassia alata* (Selvi *et al*., 2012; Jayalakshmi and Yogamoorthi, 2014; Pooja Moteriya and Sumitra Chanda, 2014 and Chanda *et al*., 2012). *Kigelia africana* is a modern system of new herbal medicine for new drug development (Sangita Saini *et al*., 2009). Synthesized nanoparticles were characterized UV-Visble spectroscopy and FTIR. Furthermore, the antibacterial activity of synthesized silver nanoparticles against *P.aeruginosa, A.hydrophila, E.tarda* and *Vibrio cholera* were explored.

****Corresponding author: Parimala, K. S.***
Department of Microbiology, School of Life Science, VELS University, Pallavaram, Chennai, Tamilnadu, India

MATERIALS AND METHODS

Collection of Plants

Seven different natural flowers were collected from the Pallavram area, Chennai and Tamilnadu. The flowers namely; *Combretum indicum* (Rangoom creeper), *Bauhinia tomentosa* (Yellow bauhiniar), *Eichhornia crassipes* (water hyacinth), *cordia sebestena* (Scarlet cordia, *Cassia alata* (senna alata), *cassia fistula* (Golden shower) and *Kigelia africana* (Sausage). 10 gram of petals (flower) were collected from each flower and washed thoroughly 3-4 times with running tap water and finally washed with distilled water and kept at room temperature for air dried.

Biosynthesis of silver nanoparticles

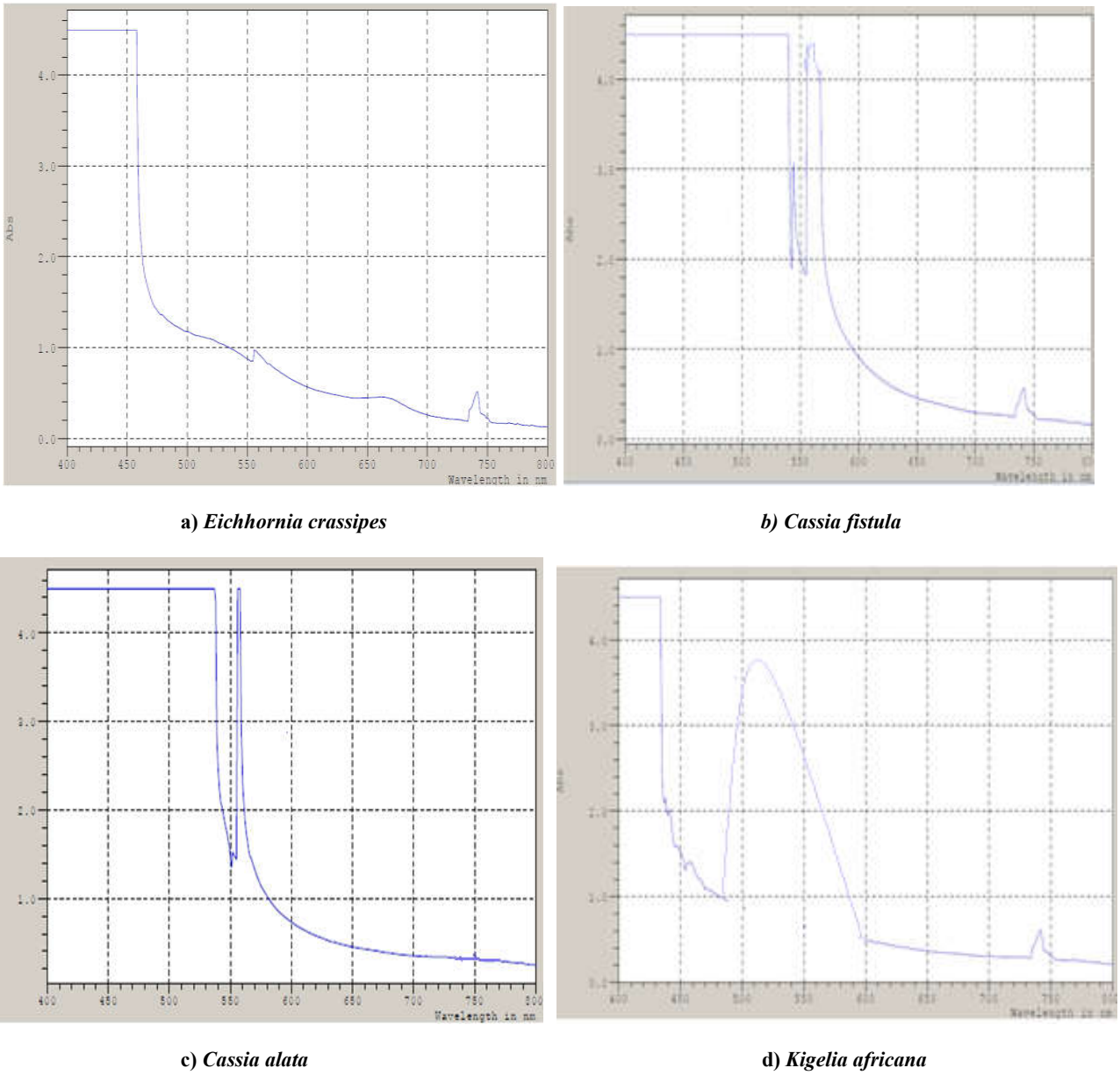
10 gram flowers were used which cut in to small pieces and immersed with 100 ml distilled water and boiled for 30 minutes and cooled. 10ml of 1mM silver nitrate solution was added in to the aqueous of flower extract then filtered through whatmann filter paper no.1. The filtered was used for these studies. For silver nanoparticles the aqueous solution was turned from yellow to brown colour was observed through the visible which indicate the confirm of the synthesis of silver nanoparticles.

Characterization of silver nanoparticles

The diluted aliquots sample was monitored through the UV-Vis spec and Fourier transforms infrared spectrometer. UV-Vis spec was performed on a DU800 spectrophotometer and it is a preliminary technique for the confirmation of synthesis of silver nanoparticles. The bio-reduction of silver ions was monitored by the UV-Vis spec with the range of 400-500nm wavelength. FTIR spec was carried out by using the Burker spectrum. The sample was prepared with the KBr pellet and the spectral range from 500cm^{-1} to 3500cm^{-1}.

Antibacterial activity by disc diffusion method

Muller-hinton agar was prepared and poured in to petriplate after solidification respective organisms like *Aeromonas hydrophila, Pseudomonas aeruginosa, Vibrio cholera* and *Edwardsiella tarda* was swabbed on the each solidified plate.



a) *Eichhornia crassipes* **b) *Cassia fistula***

c) *Cassia alata* **d) *Kigelia africana***

Figure 1. UV–vis spectra synthesis of silver Nanoparticles of flower extracts

The disc was soaked in to the synthesis of silver nanoparticles solution for 24 hours. After that the disc was placed in to the plates by using sterile forceps. The plates were incubated. After incubation the zone of inhibition was observed. Tetracycline drug was used as a control.

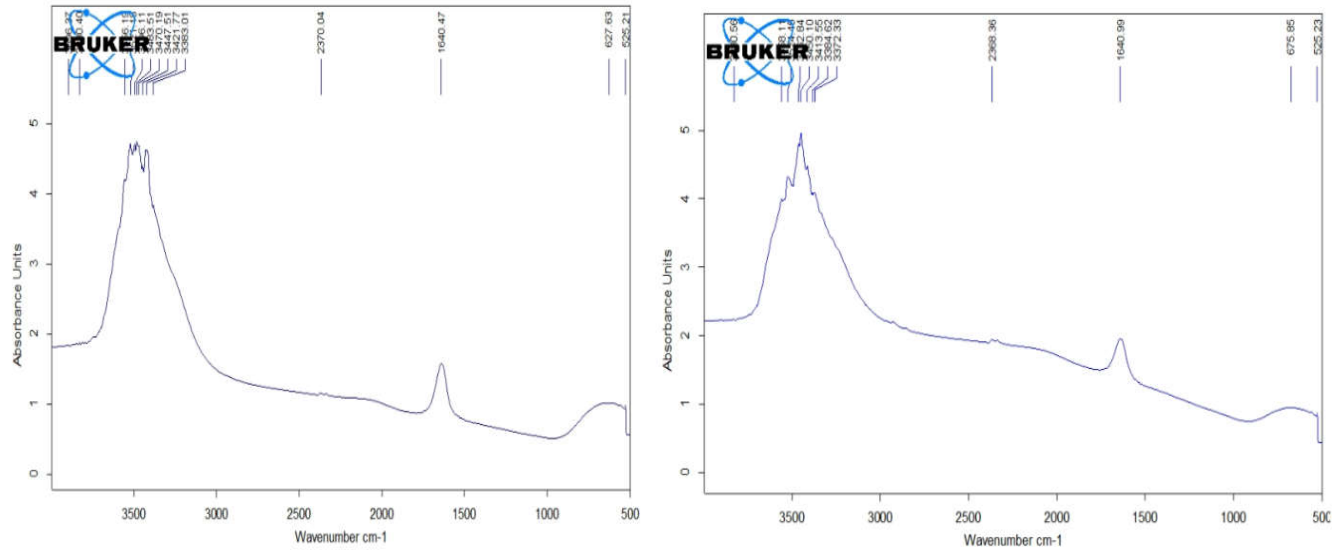
RESULTS AND DISCUSSION

In the present study, the synthesis of silver nanoparticles from the natural ornamental flower extracts namely: *Combretum indicum* (Rangoom creeper), *Bauhinia tomentosa* (Yellow bauhiniar), *Eichhornia crassipes* (water hyacinth), *cordia sebestena* (Scarlet cordial), *Cassia alata* (senna alata), *cassia fistula* (Golden shower) and *Kigelia Africana* (Sausage).

Among these extract only four flower extracts showed the positive result namely: *Eichhornia crassipes*, *cassia fistula, Cassia alata* and *Kigelia Africana*. Based on the color change which confirmed the synthesis of silver nanoparticle from the aqueous solution represented Table 1.

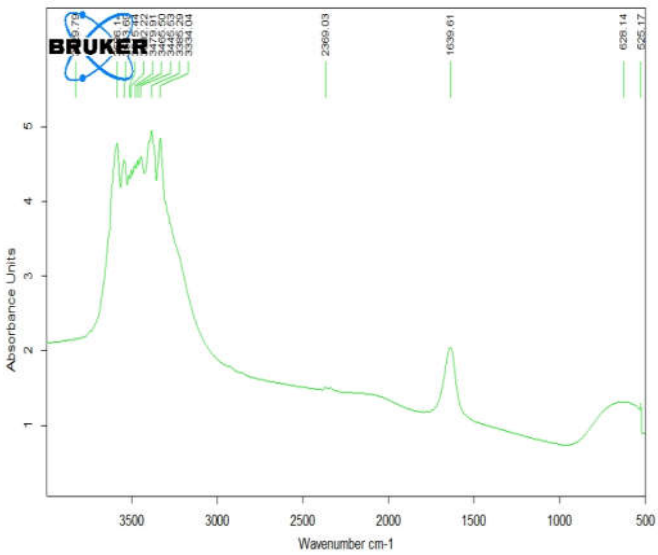
Table 1. Shows the color of the flower extract and synthesis of AgNPs flower extract

S.no	Name of the flowers	Color of the flower extracts	After synthesis of silver nitrate solution
1	Rangoom creeper	Pale black	disappear
2	Yellow bauhinia	black	colorless
3	Water hyacinth	yellow	brown
4	Scarlet cordial	Dull orange	same
5	Senna alata	yellow	brown
6	Golden shower	Dark yellow	brown
7	sausage	Dull brown	brown

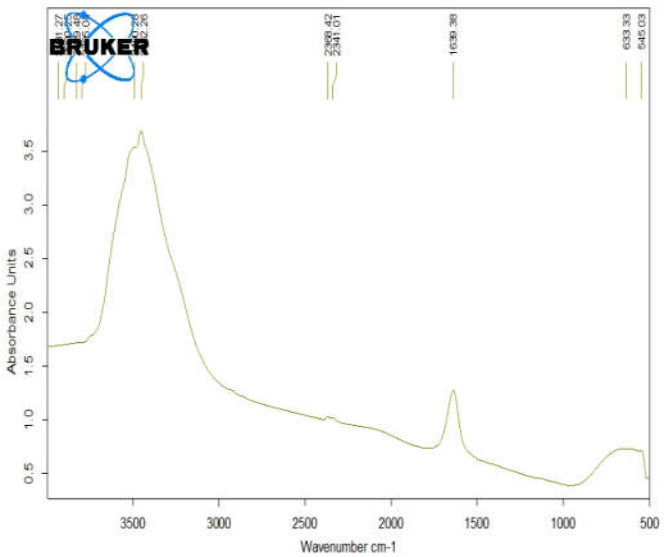


A) *Cassia alata*

b) *Cassia fistula*



c) *Eichhornia crassipes*



d) *Kigelia africana*

Fig. 2. A result of FTIR analysis to identify the possible biomolecules responsible for the reduction and capping of Ag $^{+}$ions. It showed different functional groups. The highest and lowest peak was observed in this spectrum. The aqueous *of Cassia alata* showed a highest peak range between3372.33cm^{-1}to3558.11cm^{-1}and 2368.36cm^{-1}. The lowest peak at 675.85 cm^{-1} 525.23cm^{-1}. *Cassia fistula* showed a highest peak range between 3383.01 cm^{-1} to 3536.19cm^{-1} and 2370.04cm^{-1}.The minor peak showed a 627.13 cm^{-1} and 525.21 cm^{-1}. *Eichhornia crassipes* showed a maximum peak range 3334.04 to 3596.11cm. The lowest band showed a628.14 cm^{-1} and 525.17 cm^{1}. *Kigelia Africana* showed a strong IR bands range 3766.04 cm^{-1} to 3812.27cm^{1}. The lowest band peak at 633.33 cm^{-1} and 545.03 cm^{1}. The peaks near showed a strong absorption band at 3766.04 cm^{-1}to3362.26 cm^{-1} were assigned to C-H stretching and OH stretching respectively. The weakest band corresponds to amide group which indicate the presence of proteins

Table 2. Antibacterial activity of silver nanoparticles and plant extracts: Zone of inhibition in mm

Name of the plants	P.aeruginosa		A.hydrophila		V.cholerae		E.tarda	
	P.E	AgNPs	P.E	AgNPs	P.E	AgNPs	P.E	AgNPs
C.alata	7	12	3	7	3	8	NZ	NZ
C.fistula	8	13	4	9	6	10	NZ	NZ
K.africana	4	12	2	9	NZ	3	NZ	NZ
E.crassipes	7	14	4	9	8	12	NZ	NZ

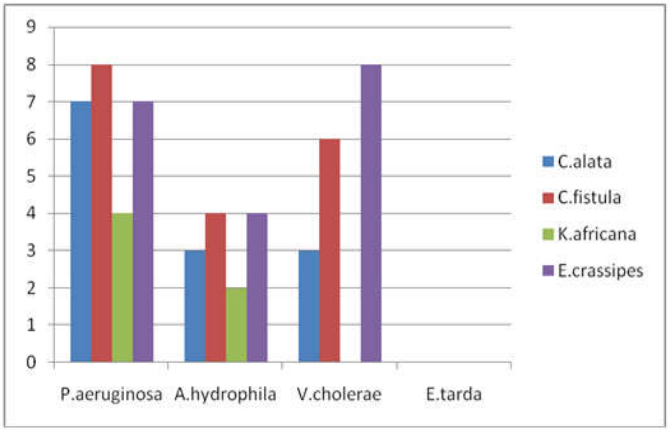
Note: PE- plant extract
AgNPs-Synthesis of silver nanoparticles
NZ-no zone

Fig. 1 Plant extract was added to the 1mM silver nitrate solution the color change was observed which indicating the formation of AgNPs. UV-vis absorption spectrum was observed the strong narrow and broadening peaks at 560nm of each aqueous solution which indicating the formation of silver nanoparticles. *C.alata* and *C.fistula* showed the narrow peak. Fig. 2 show a result of FTIR analysis to identify the possible biomolecules responsible for the reduction and capping of Ag^{+}ions. It showed different functional groups.

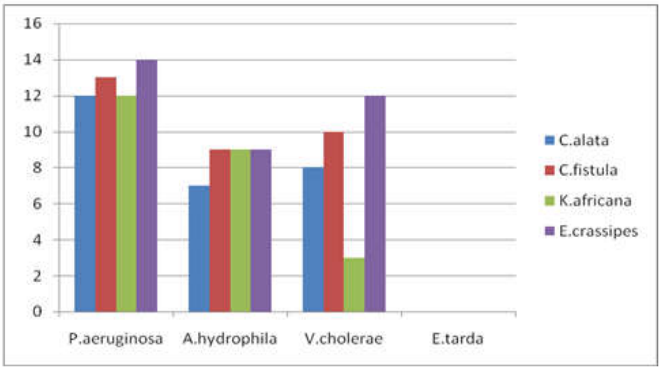
The highest and lowest peak was observed in this spectrum. The aqueous *of Cassia alata* showed a highest peak range between3372.33cm^{-1}to3558.11$cm^{-1}$and 2368.36cm^{-1}. The lowest peak at 675.85 cm^{-1} 525.23cm^{-1}. *Cassia fistula* showed a highest peak range between 3383.01 cm^{-1} to 3536.19cm^{-1} and 2370.04cm^{-1}.The minor peak showed a 627.13 cm^{-1} and 525.21 cm^{-1}. *Eichhornia crassipes* showed a maximum peak range 3334.04 to 3596.11cm. The lowest band showed a628.14 cm^{-1} and 525.17 cm^{-1}. *Kigelia Africana* showed a strong IR bands range 3766.04 cm^{-1} to 3812.27cm^{1}. The lowest band peak at 633.33 cm^{-1} and 545.03 cm^{-1}. The peaks near showed a strong absorption band at 3766.04 cm^{-1} to 3362.26 cm^{-1} were assigned to C-H stretching and OH stretching respectively. The weakest band corresponds to amide group which indicate the presence of proteins.

Antibacterial activity by disc diffusion method

In this study, the antibacterial activity of silver nanoparticles and plant extracts was tested by disk diffusion method against pathogenic bacteria *Aeromonas hydrophila, Pseudomonas aeruginosa, Vibrio cholera* and *Edwardsiella* tarda were reported in Table 2.



Antibacterial activity of plant extracts



Antibacterial activity of silver nanoparticles

Pseudomonas aeruginosa showed a highest activity than the *Aeromonas hydrophila* and *Vibrio cholera. Edwardsiella tarda* showed a no zone around the discs. Graph-1 & 2 show the synthesis of silver nanoparticles showed a maximum activity when compared to plant extracts.

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